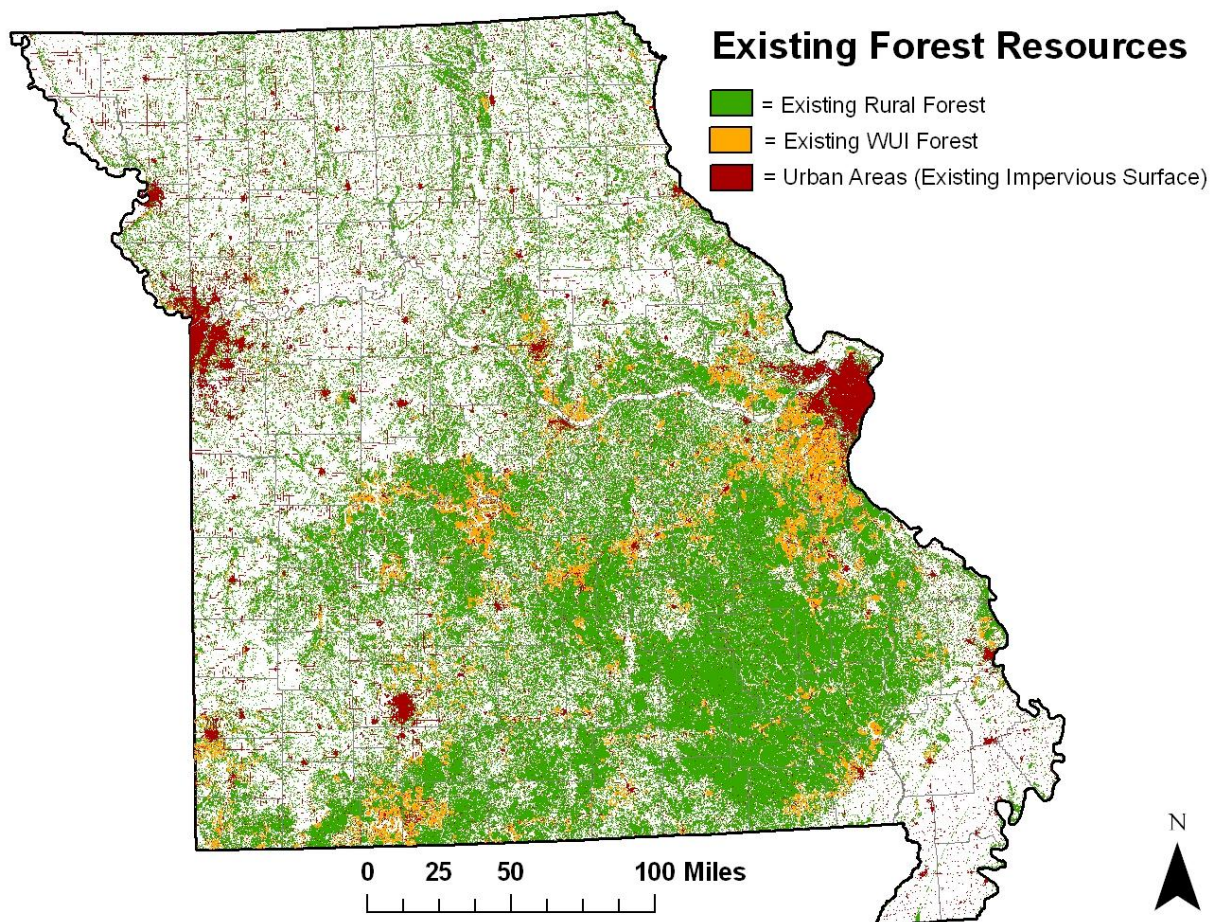


Chapter 4: Forest Opportunity Areas

The 11 Issue Themes reveal that much work is needed to ensure a sustainable future for Missouri's forest resources. In order to promote the most efficient, strategic, and effective use of limited resources for addressing forest threats and opportunities identified in Chapter 3, Missouri's Forest Resource Assessment and Strategy (FRAS) establishes Forest Opportunity Areas.

Forest Opportunity Areas (FOA): Areas which offer Missouri's best geographic opportunities for sustaining forest resources and the benefits and services derived from them. The term "forest" is used here in the broadest of senses to include all forest and woodland natural communities, associated natural communities and features such as streams, caves, and urban areas.

FOAs include rural, wildland-urban interface (WUI), and urban settings. The existing distribution of all existing forest resources is shown below. For the purposes of FRAS, FOAs are lumped into two categories: "Rural/WUI", and "Urban". Chapter 4 presents our methodology for determining Rural/WUI and Urban FOAs and the results.



Rural/WUI Forest Opportunity Areas:

The Forest Opportunity Model

In order to identify the best geographic opportunities for sustaining Missouri's rural and WUI forest resources, a **"Forest Opportunity Model"** was developed. The Forest Opportunity Model evaluates forest opportunity on individual quarter acre cells across the state with 8 Data Sets. Each cell gets a score of up to 10 points for each Data Set, and then a composite score of up to 80 points (8 data sets times 10 points) which is used to compare the forest opportunity between cells.

Forest Opportunity Model Data Sets:

Forest Benefits and Attributes:

1. Biodiversity
2. Forest Productivity and Carbon Sequestration
3. Soil and Water Conservation
4. Recreation and Social Values
5. Forest Patch Size

Forest Vulnerabilities:

6. Current Harvest Pressure
7. Insect and Disease Vulnerability
8. Housing Density Projections

The first five Data Sets represent important "benefits and attributes" of forests. The last 3 Data Sets represent significant "vulnerabilities" to sustainability which could be minimized through implementation of our Forest Resource Strategy. Essentially, the more important a cell is, plus the more vulnerable the cell is to stressors which we can positively influence, the greater the "opportunity".

An example of how this works is Labarque Creek watershed in Jefferson County. This watershed is of especially high importance for biodiversity and public drinking water quality, but it is also under great development pressure. This development pressure could be minimized through practices such as "smart growth planning", conservation easements, and working with landowners. Therefore, this landscape is a good place to invest resources. Other areas may be just as ecologically important, but are less vulnerable to degradation. Therefore, it is less urgent to invest resources in these places. Some other places might be even more vulnerable than Labarque Creek watershed, but less able to provide important benefits. Therefore, they pose less opportunity as well.

The following pages provide a more thorough description of the Forest Opportunity Model Data Sets, and the composite model results.

Data Set One: Biodiversity

Description: This data set includes three primary components: 1) Conservation Opportunity Areas (COA) identified in Missouri's Comprehensive Wildlife Strategy which include significant forest and woodland components; 2) Forest/woodland dominated Natural Areas (NA); and 3) Forest-dependent natural heritage points and hot spots. NAs and heritage points/hotspots include a 1/4 mile-wide buffer. Points are allocated as follows:

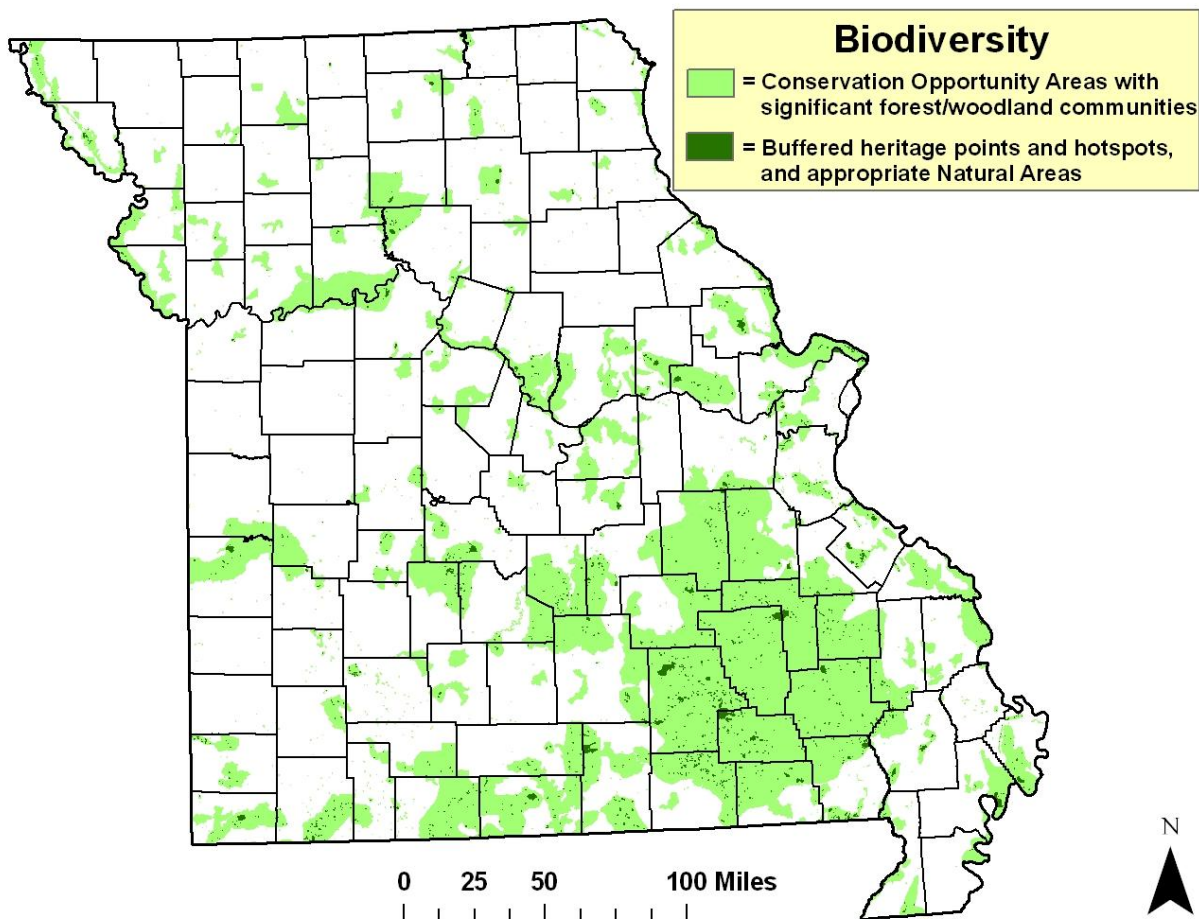
Cells which are in a COA and NA or heritage point/hotspot = 10 Points

Cells which are in a COA only = 8 points

Cells which are NA or heritage point/hotspot, but not in a COA = 8 points

Significance: This layer represents areas in which forest/woodland conservation and restoration has the greatest potential to conserve Missouri's biological diversity.

Data Sources: Comprehensive Wildlife Strategy COAs (which includes aquatic COAs), Natural Areas Database, Natural Heritage Database



Data Set Two: Forest Productivity and Carbon Sequestration

Description: This data set includes areas well suited to forest/woodland with the greatest potential to produce quality timber and sequester carbon. Historic vegetation mapping (1795-1852) is used with the following assumptions: 1) Areas which were historically forest or closed woodland are well suited to this cover type and are generally productive; 2) Areas which were historically open woodland are generally less productive than forests and closed woodlands; 3) Areas which were historically barren/scrub are transitional sites that are variably well suited to forest/woodland, and variably productive; and 4) Areas which are currently forest/woodland, but were not historically forest/woodland may be growing on sites better suited to prairie or glade. However, these forests still contribute to production and carbon sequestration. Points are allocated as follows:

Cells which were historically Forest or Closed Woodland = 10 points

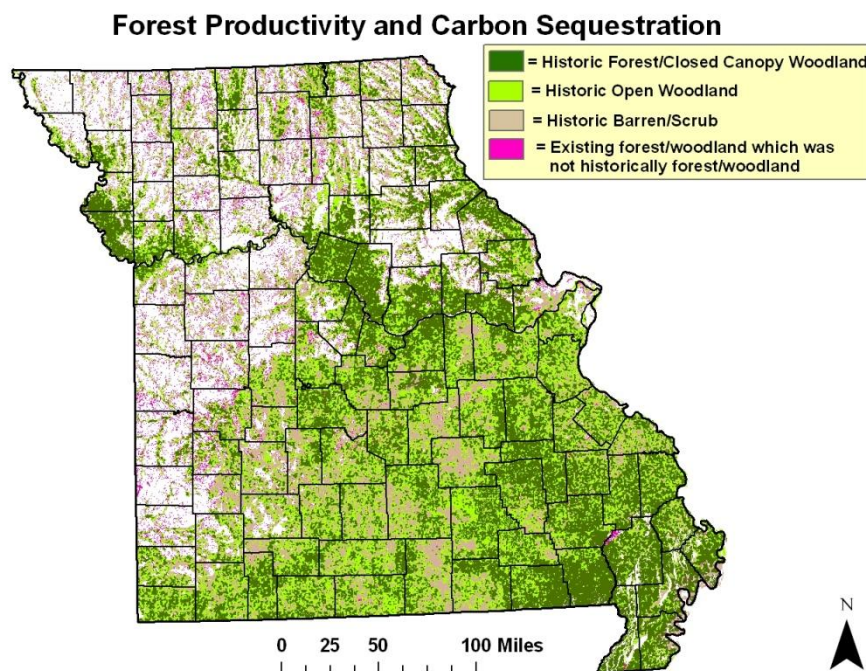
Cells which were historically Open Woodland = 8 points

Cells which were historically Barren/Scrub = 6 points

Cells which are currently forested, but were not historically = 4 points

Relevance: This layer represents: 1) areas with the greatest potential for producing high quality forest products; 2) areas which are most likely to be targeted for harvesting; 3) non-forested areas which are particularly well suited to reforestation; and 4) areas capable of sequestering and storing significant amounts of carbon (This assumes that highly productive sites can store more carbon. However, more research is needed).

Data Sources: National Land Cover Database – 2001; Historic Vegetation Map – Geographic Resources Center, Department of Geography, University of Missouri.



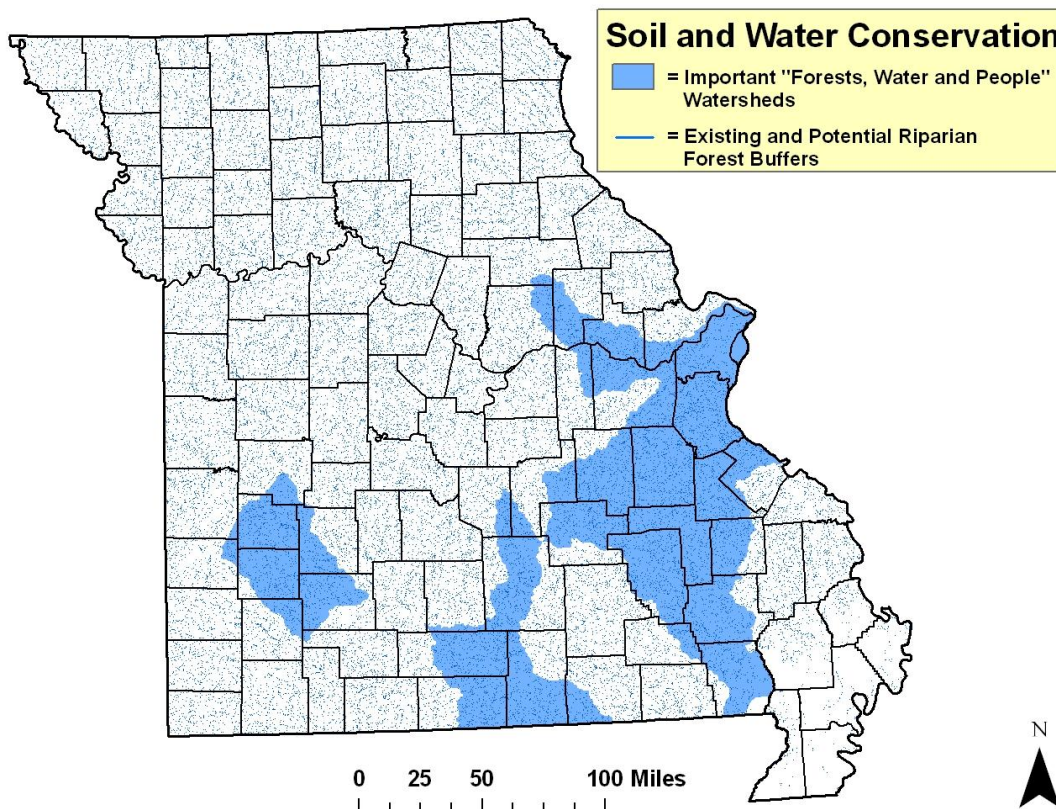
Data Set Three: Soil and Water Conservation

Description: This layer is comprised of two general criteria: 1) Areas identified as priority drinking water supply forest watersheds in the U.S. Forest Service's Forests, Water and People Assessment¹; and 2) Existing and potential riparian forests. Points are allocated as follows:

200 foot-wide stream buffers on each side of permanent "blue line" streams = FOA
100 foot-wide stream buffers on each side of intermittent "blue line" streams = FOA
Non-buffer areas within high priority watersheds (top FWPA tiers) = 6 points

Relevance: This layer represents: 1) forest areas in which protection of water quality is of the greatest importance for maintaining clean and affordable public drinking water supplies; 2) areas with the greatest potential for minimizing soil loss and maintaining or improving water quality (riparian buffers).

Data for this layer comes from the following sources: USFS's Forests, Water and People Assessment¹, National Hydrography Dataset (NHD) Data



¹ Barnes, M.C, A.H. Todd, R. Whitney Lilja, and P.K. Barten. 2009. Forests, Water and People: Drinking water supply and forest lands in the Northeast and Midwest United States. Newtown Square, PA: U.S. Dept. of Agriculture, Forest Service, Northeastern Area State and Private Forestry. For more information on this study, visit: http://www.na.fs.fed.us/watershed/fwp_preview.shtm

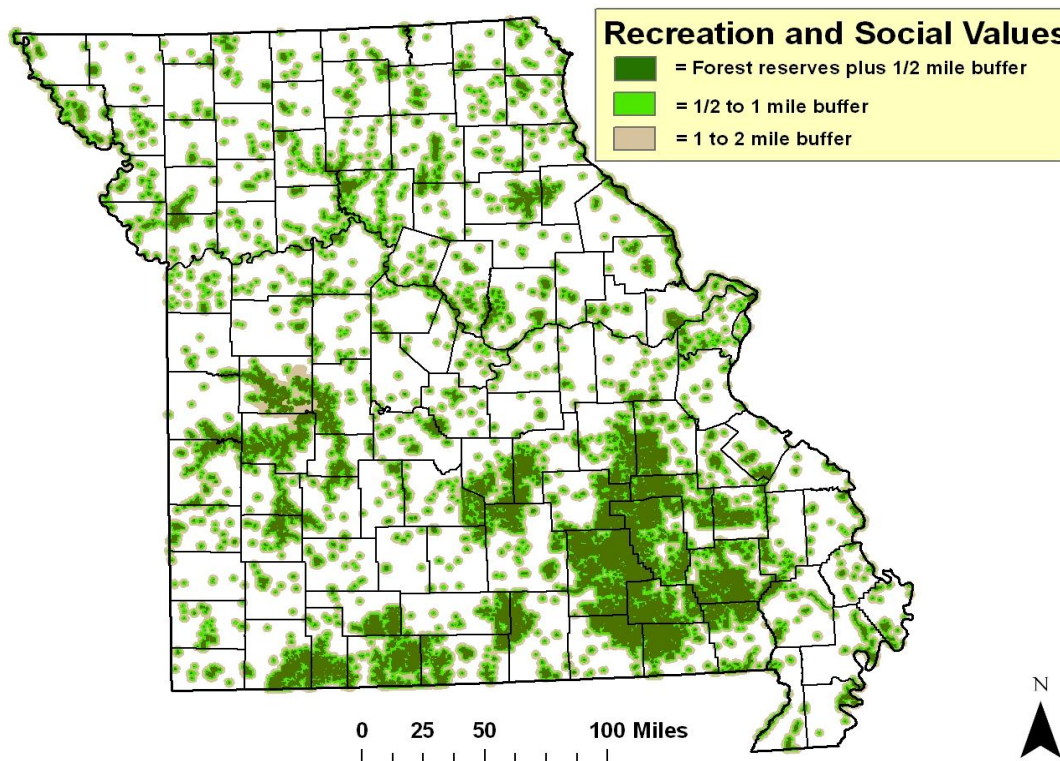
Data Set Four: Recreation and Social Values

Description: This data set includes publicly-owned land (mostly forested, but not all) plus privately-owned land under conservation easement or other legal protection to prohibit development, to the extent that this information is available. Collectively, these tracts will be referred to as “reserves”. This layer also includes buffers around reserves:

Cells on public and private forest reserves = 10 points
Cells within ½ mile of reserves = 10 points
Cells ½-1 mile distance of reserves = 8 points
Cells 1-2 mile distance of reserves = 6 points

Relevance: Publicly-owned forest land provides terrific recreation opportunities, aesthetics, psychological benefits and more. Privately-owned forest reserves also provide a number of social and intrinsic values. These tracts are expected to remain forested indefinitely and generally have legal requirements for sustainable forest management practices. Buffers around forest reserves help to maintain the ecological and social integrity of these reserves. Besides the great importance of forest reserves to the public, they are also especially worthy of enhanced funding and attention because there is assurance that such investment will be sustained into the future.

Data for this layer comes from the following sources: MDC’s public land data, plus data provided by NRCS, Ozark Regional Land Trust and The Nature Conservancy on privately owned protected land.



Data Set Five: Forest Patch Size

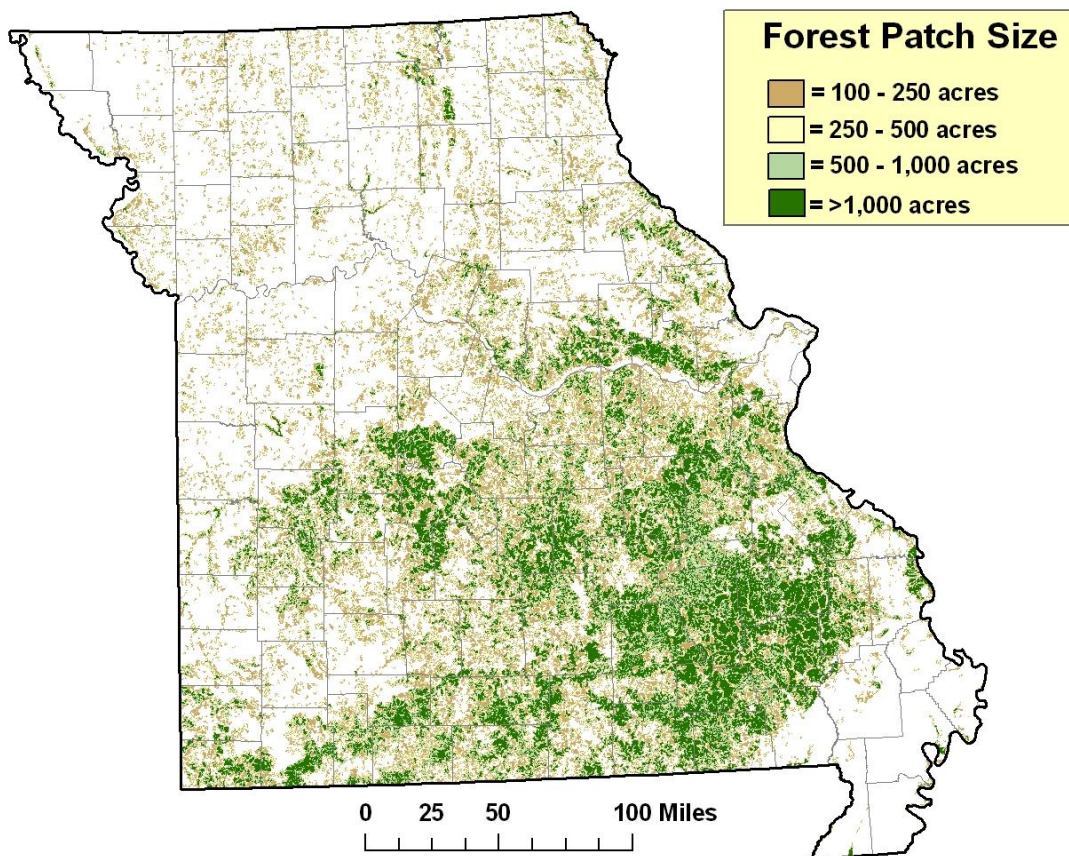
Description: Large contiguous forest patches.

Cells in forest patches > 1,000 acres = 10 points
Cells in forest patches 500-1,000 acres = 8 points
Cells in forest patches 250-500 acres = 6 points
Cells in forest patches 100-250 acres = 4 points

Relevance: Large forest patches are better able to provide many benefits compared to smaller forest patches. Large forest patches provide unique habitat for fish and wildlife which helps to maintain Missouri's plant and animal biodiversity. Larger forest patches provide greater flexibility in forest management options – including prescribed fire, timber harvesting, and non-commercial thinning. Larger forest patches are also better able to provide environmental services such as clean water and carbon sequestration compared to more fragmented forests. An additional advantage of large forest patches is that they are less vulnerable to numerous negative “edge” effects such as exotic invasive plants, animals and diseases.

Data for this layer comes from the following sources:

Analysis of 2001 National Land Cover Database data



Data Set Six: Current Harvest Pressure

Description: Forestland rated by current harvest pressure per forest acre per year based on Primary Wood Processor Survey data. Sawmill output and sourcing radius is extrapolated to determine average harvest pressure per acre of existing forest per year. Areas experiencing the greatest pressure get the most points:

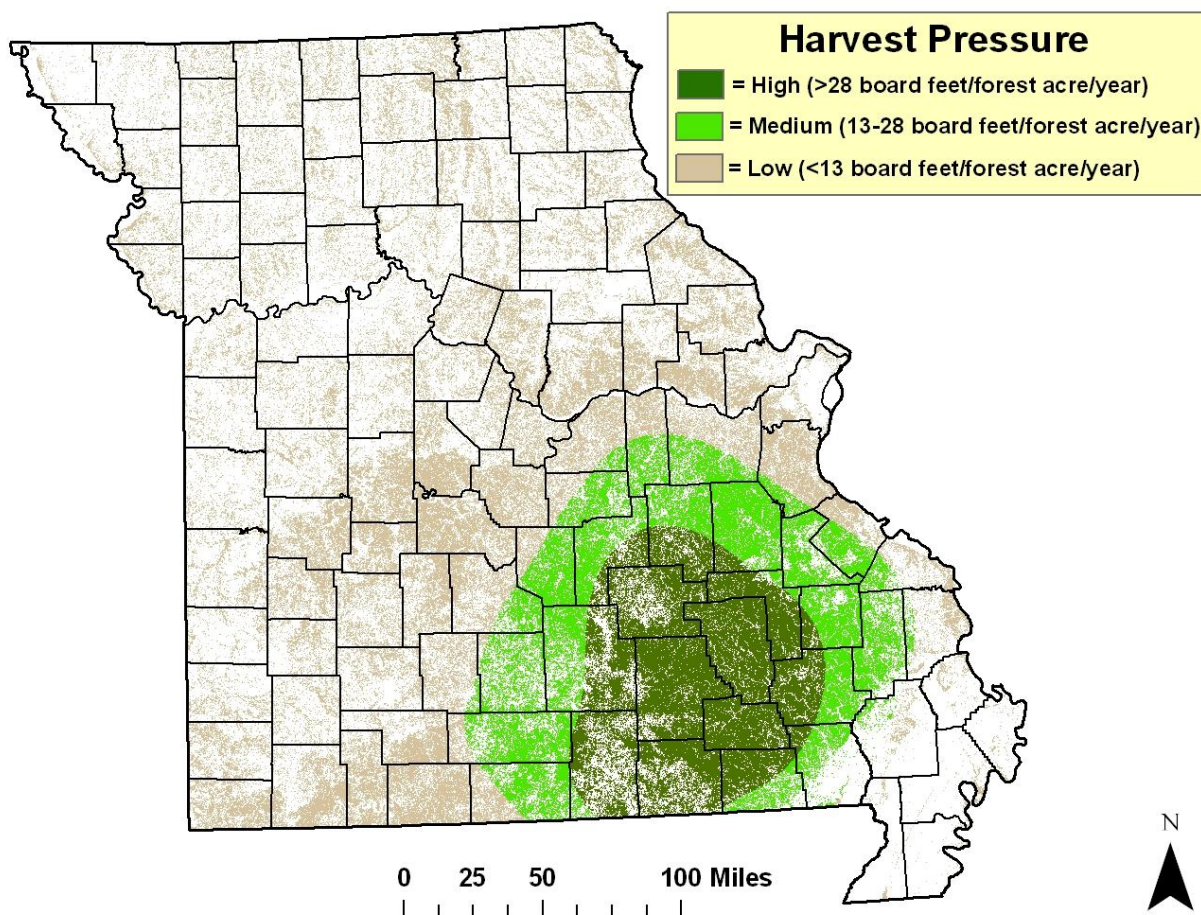
Cells in the top tier (>28 board feet/forest acre/year) = 10 points

Cells in the next tier (13-28 board feet/forest acre/year) = 8 points

Cells in the next tier (<13 board feet/forest acre/year) = 6 points

Relevance: Areas of greater current harvest pressure have a greater need for forester availability to ensure harvesting is conducted in a sustainable manner. This also represents areas in which communities are especially economically dependent on the harvest and production of forest products.

Data for this layer comes from the following sources: Forestry Division Primary Wood Processor Survey information and 2001 NLCD data



Data Set Seven: Insect and Disease Vulnerability

Description: Areas most prone to tree mortality from insects and diseases from 2006 through 2020. Red oak group decline is the primary influencer, but ash decline, Dutch elm disease and gypsy moth are also incorporated into this assessment.

Cells with projected tree mortality of >25% basal area = 10 points

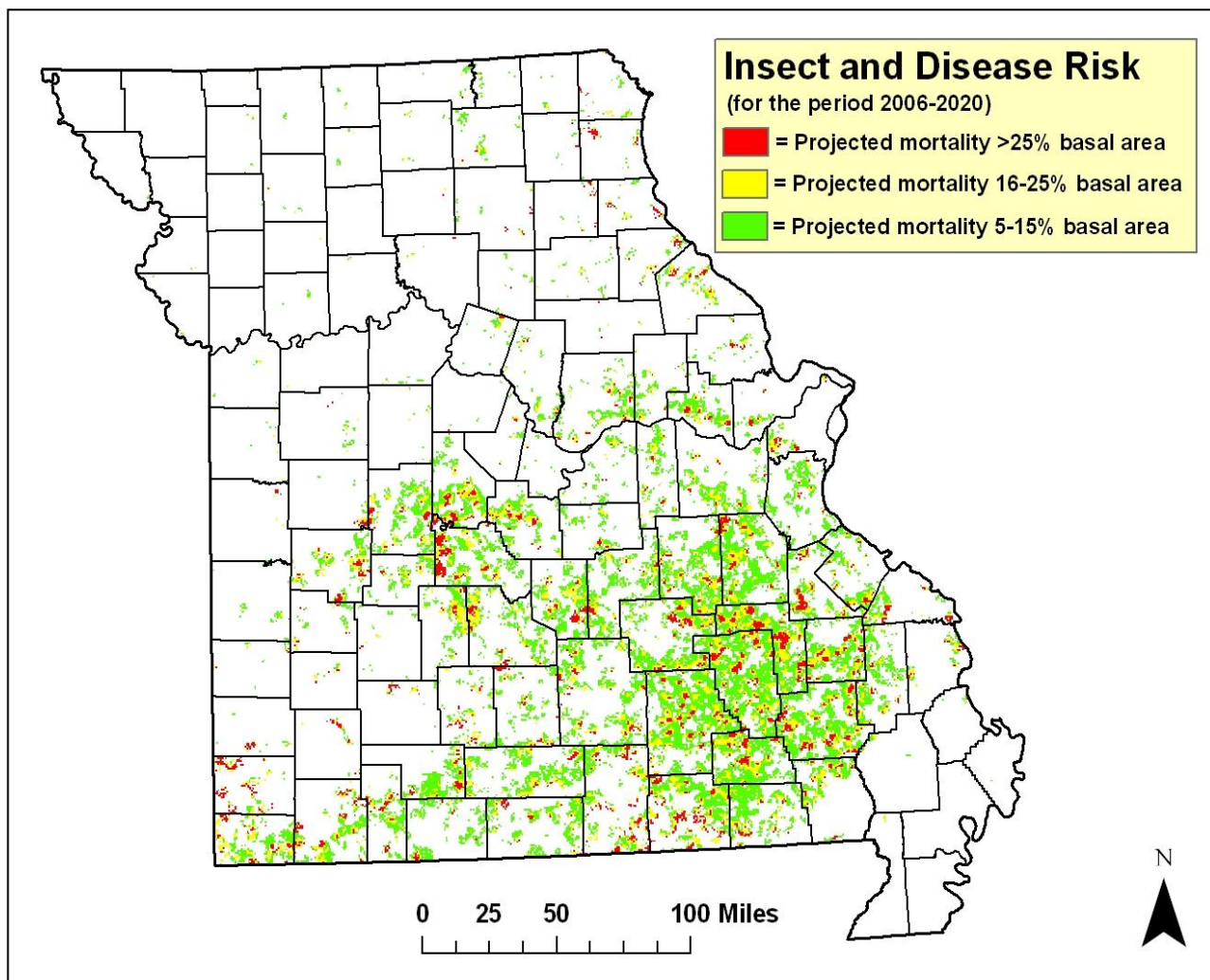
Cells with projected tree mortality of 16-25% basal area = 8 points

Cells with projected tree mortality of 5-15% basal area = 6 points

Relevance: This layer represents areas most prone to tree mortality from insects and diseases from 2006 through 2020. These areas need increased attention to minimize mortality and/or economic losses, and to ensure a healthy forest emerges following mortality.

Data for this layer comes from the following sources:

U.S. Forest Service National Disease and Risk Map



Data Set Eight: Housing Density Projections

Description: Areas identified as vulnerable to development through 2030*.

High projected increase in housing density = 10 points
Moderate projected increase in housing density = 8 points
Low projected increase in housing density = 6 points

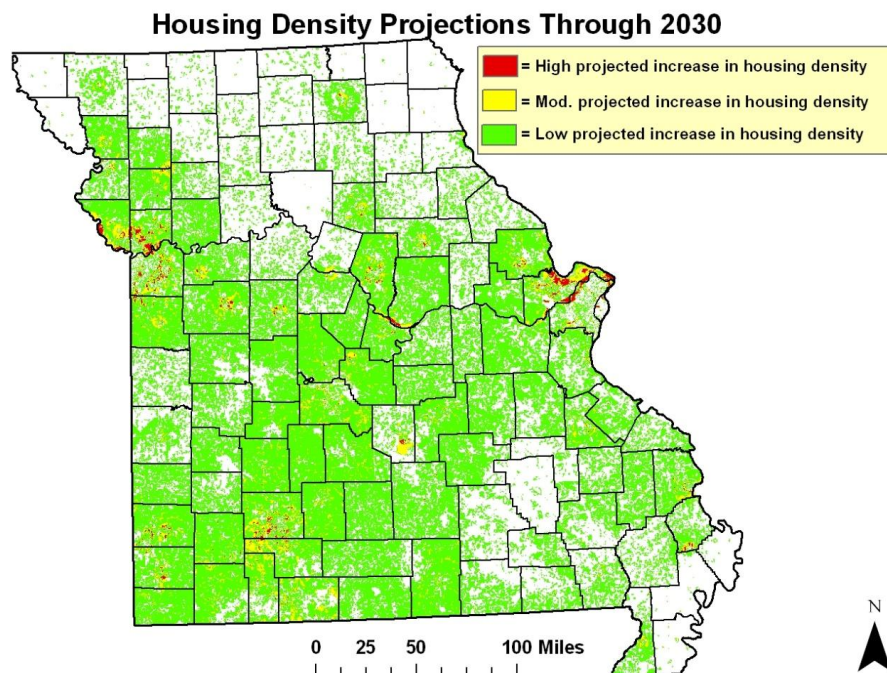
Relevance: These areas are subject to increased threat of development, fragmentation and parcelization in the next ~20 years. These threatened areas which overlap with FOAs represent high priority areas for targeting land conservation efforts (smart growth planning, conservation easements, etc.).

Data Source: David Theobald's Housing Density Projection Assessment²

* Measured at the census block level using the projected change in acres/housing unit.

- High projected housing density increase ≥ 15 acre decrease in acres per housing unit.
- Moderate projected housing density increase = 10-15 acre decrease in acres per housing unit.
- Low projected housing density increase = 5-10 acre decrease in acres per housing unit.

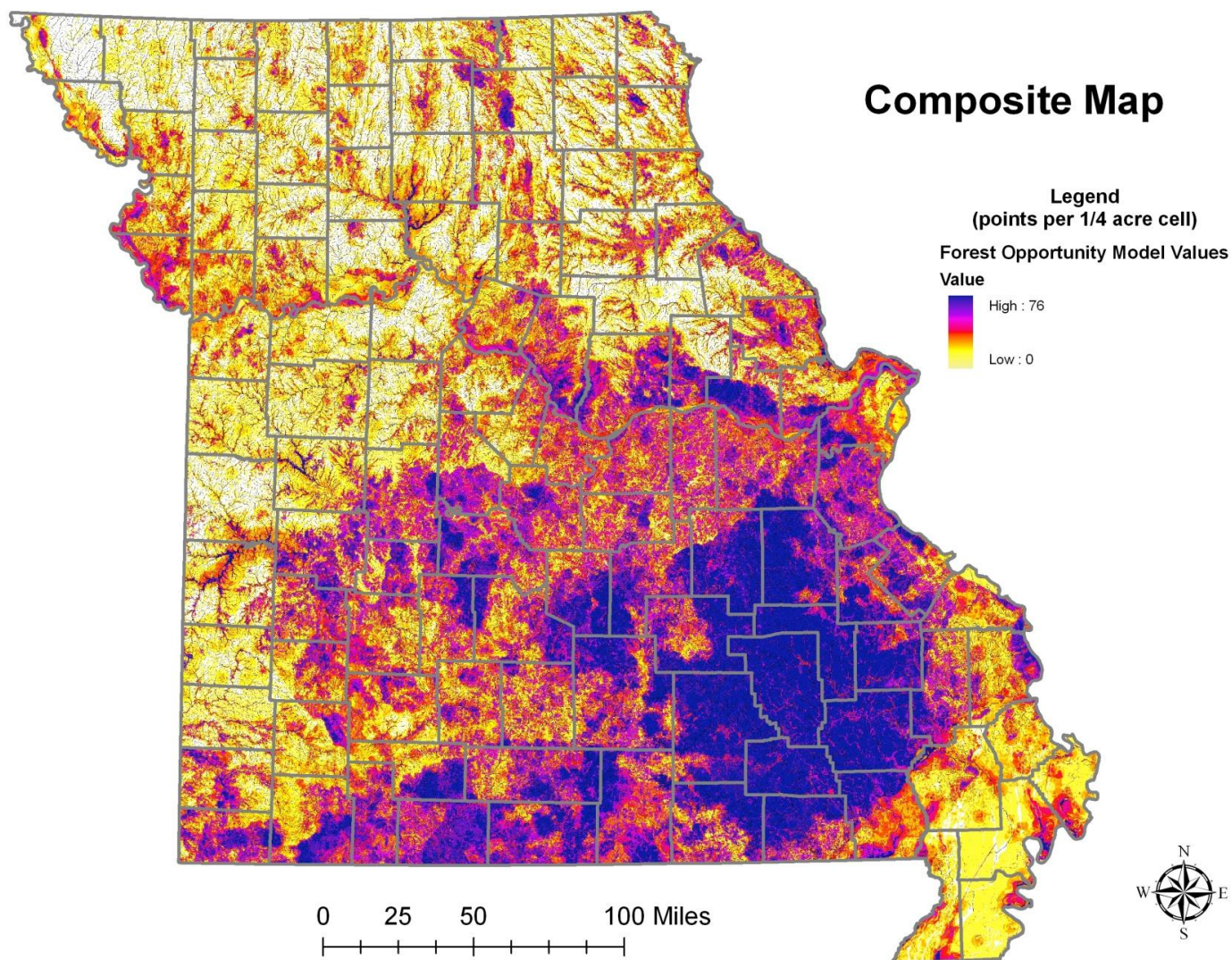
For example, if a census block with 30 acres per housing unit is projected to change to 18 acres per housing unit (due to increased houses), there is a 12 acre projected decrease of acres per housing unit, which is considered Moderate.



² Theobald, D.M. 2004a. bhc2000 v.1. Environmental Systems Research Institute (ESRI) raster digital data. On file with: David M. Theobald, Natural Resource Ecology Lab, Colorado State University, Fort Collins, CO 80526, and, Theobald, D.M. 2004b. bhc2030 v.1. Environmental Systems Research Institute (ESRI) raster digital data. On file with: David M. Theobald, Natural Resource Ecology Lab, Colorado State University, Fort Collins, CO 80526.

Forest Opportunity Model - Composite Score Map

As the Data Set scores for each $\frac{1}{4}$ acre cell are added up, they result in the following Composite Score Map. On the color spectrum shown below, the darkest areas represent the greatest opportunities for sustaining forests and forest benefits.



Rural/WUI Forest Opportunity Area Designation

Building upon the Forest Opportunity Model, the following places are recognized as Rural/WUI Forest Opportunity Areas:

1. The highest scoring tier of ¼ acre cells³ from the Forest Opportunity Model.
2. All riparian areas within 200 feet of permanent “blue line” tributaries and 100 feet of intermittent “blue line” tributaries⁴.
3. The highest scoring tier of watersheds using the Forest Opportunity Model⁵.
4. Additional areas which uniquely promote the Seven Criterion of Forest Sustainability, upon approval of the State Forester.

Much of Missouri’s Forest Opportunity Areas are also recognized as Priority Forest Landscapes. **Priority Forest Landscapes (PFL)** are large landscapes (generally >10,000 acres) of concentrated FOA. PFLs will be used for strategic planning, stakeholder collaboration, and conservation marketing. All areas within a PFL are considered FOA.

The following map shows the resulting Forest Opportunity Areas, including PFLs. On this map, approximately 50% of Missouri’s existing forestland is recognized as Forest Opportunity Area.

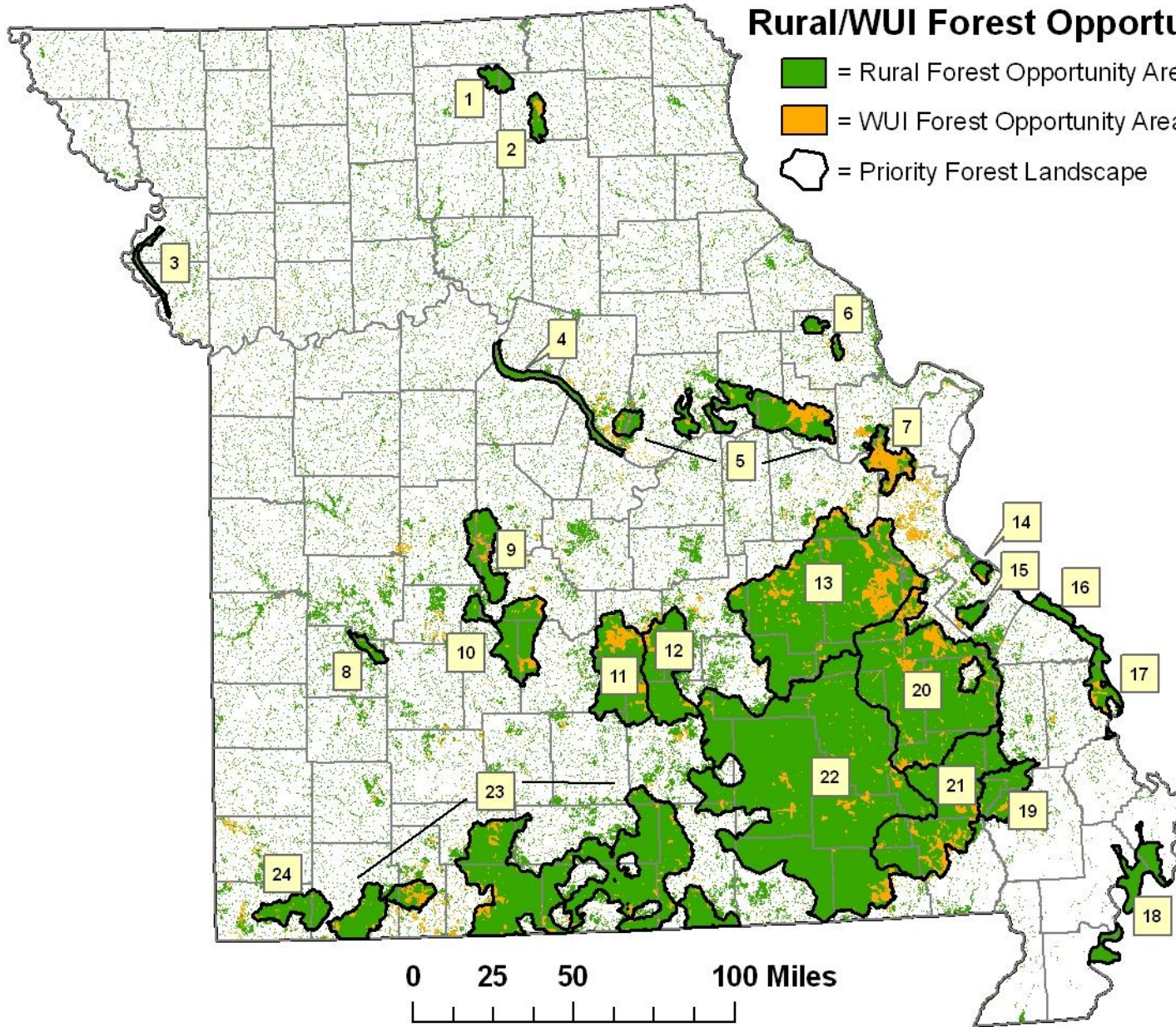
³ Tiers are established by applying three natural breaks using ArcGIS. All cells scoring 0 points were dropped out prior to calculating the natural breaks.

⁴ FRAS recognizes that some riparian areas may be well suited to grassland uses as well. However, delineating which riparian areas are better suited to forest vs. grassland has proven to be problematic. FRAS includes all riparian areas and leaves it to the discretion of the land manager to make this determination.

⁵ For this calculation, each 12 digit HUC watershed was given an average score using the Forest Opportunity Model. Tiers were then established by applying three natural breaks using ArcGIS.

Rural/WUI Forest Opportunity Areas

- = Rural Forest Opportunity Area
- = WUI Forest Opportunity Area
- = Priority Forest Landscape



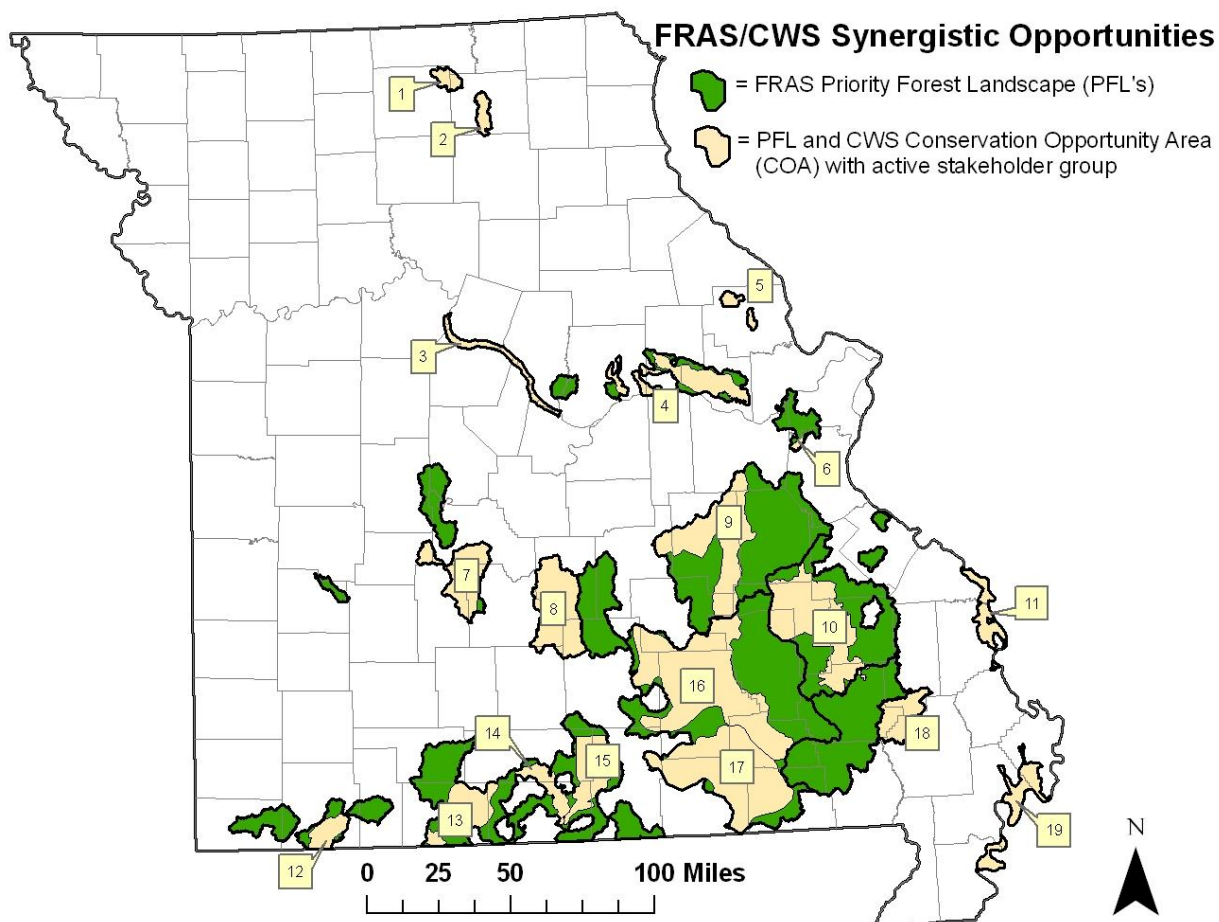
Priority Forest Landscapes:

1. Union Ridge
2. Thousand Hills Woodland
3. Iatan/Weston
4. Manitou Bluffs
5. Missouri River Hills
6. Cuivre River Hills
7. Lower Meramec/Missouri
8. Lower Sac
9. Lake of the Ozarks
10. Niangua Basin
11. Upper Gasconade
12. Big Piney
13. Meramec River Hills
14. Establishment Creek
15. Jonca Creek
16. Middle Mississippi
17. Cape Hills
18. River Bends
19. Mingo Basin
20. St. Francois Knobs
21. Black River Ozark Border
22. Current River Hills
23. White River Hills
24. Elk River Hills

Synergies with Missouri's Comprehensive Wildlife Strategy (CWS)

CWS identifies 19 forest/woodland Conservation Opportunity Areas (COA) with dedicated stakeholder groups. These COAs nest almost entirely within PFLs. While the goals of FRAS and CWS vary slightly, these two initiatives have much in common. FRAS will work closely with these COA stakeholder groups for the purposes of collaborating on strategies, marketing, applying for grants, etc. Detailed profiles of each of these COAs can be found in CWS's "Directory of Conservation Opportunity".

A likely FRAS strategy will be to develop additional stakeholder groups tied to PFLs.



CWS Forest/Woodland Conservation Opportunity Areas with active stakeholder groups:

- | | |
|--------------------------------|-------------------------------------|
| 1. Union Ridge | 11. St. Francois Knobs |
| 2. Thousand Hills Woodland | 12. Cape Hills |
| 3. Iatan/Weston | 13. Roaring River |
| 4. Manitou Bluffs | 14. White River Glades and Woodland |
| 5. Missouri River Hills | 15. Bryant Creek |
| 6. Cuivre River Hills | 16. North Fork |
| 7. Labarque Creek | 17. Current River Hills |
| 8. Niangua Basin | 18. Eleven Point Hills |
| 9. Upper Gasconade River Hills | 19. Mingo Basin |
| 10. Middle Meramec | 20. River Bends |

Urban Forest Opportunity Areas

The issues, threats and opportunities facing urban forests are often different from forests in Rural/WUI areas. Therefore, a separate assessment is needed. Unfortunately, much of the data that would facilitate a high resolution urban forest assessment have not yet been developed. Therefore, FRAS approaches Urban FOAs with a two phase approach:

In Phase One, Urban FOAs are identified as Missouri's 10 largest metropolitan areas, based on population and concentration of impervious surface. Most FRAS urban forest goals and strategies are oriented towards providing social benefits to people or improving environmental quality in the places that people live, work and play. Therefore, FRAS urban forest efforts will be focused on areas with the greatest concentrations of people.

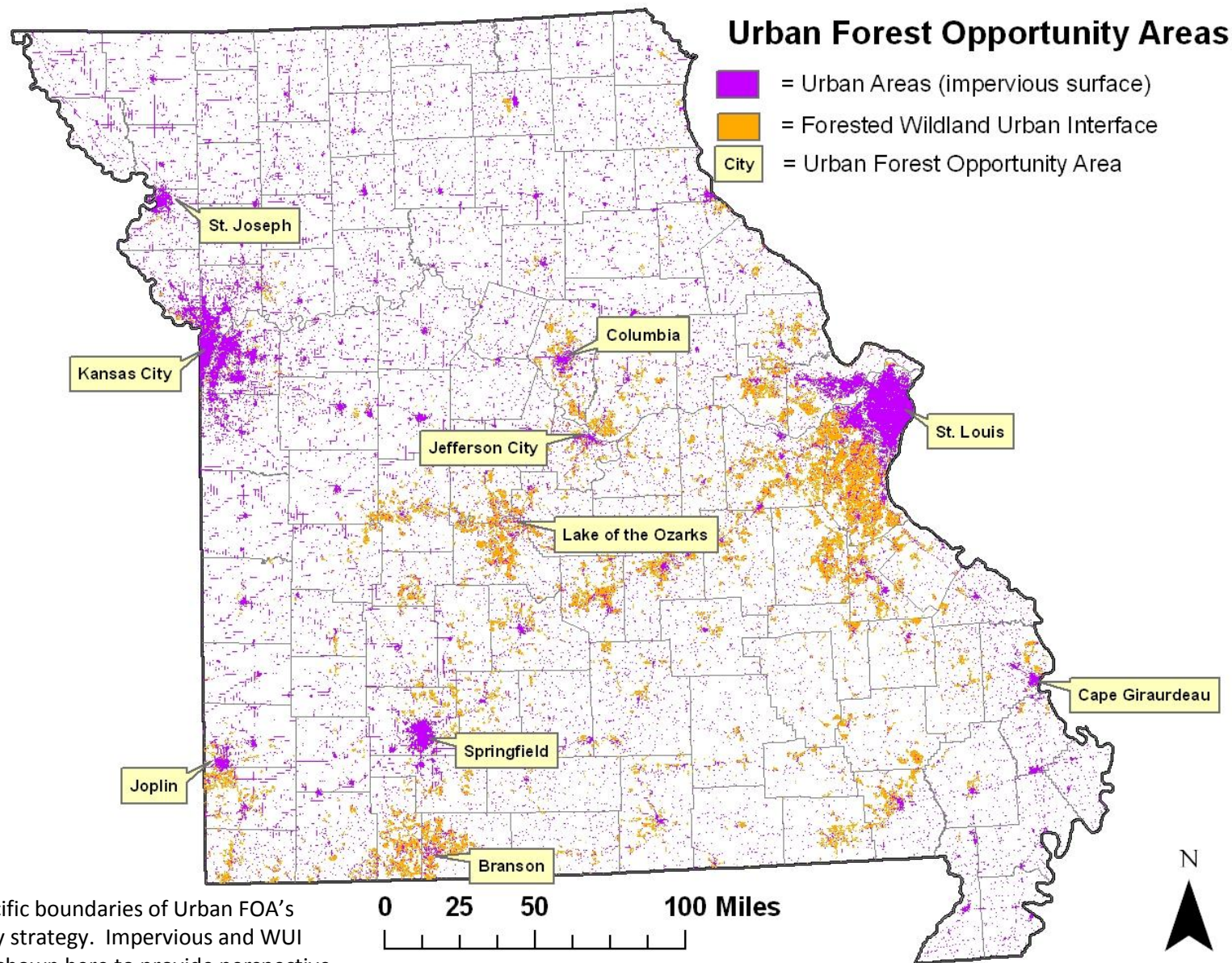
Urban Forest Opportunity Areas

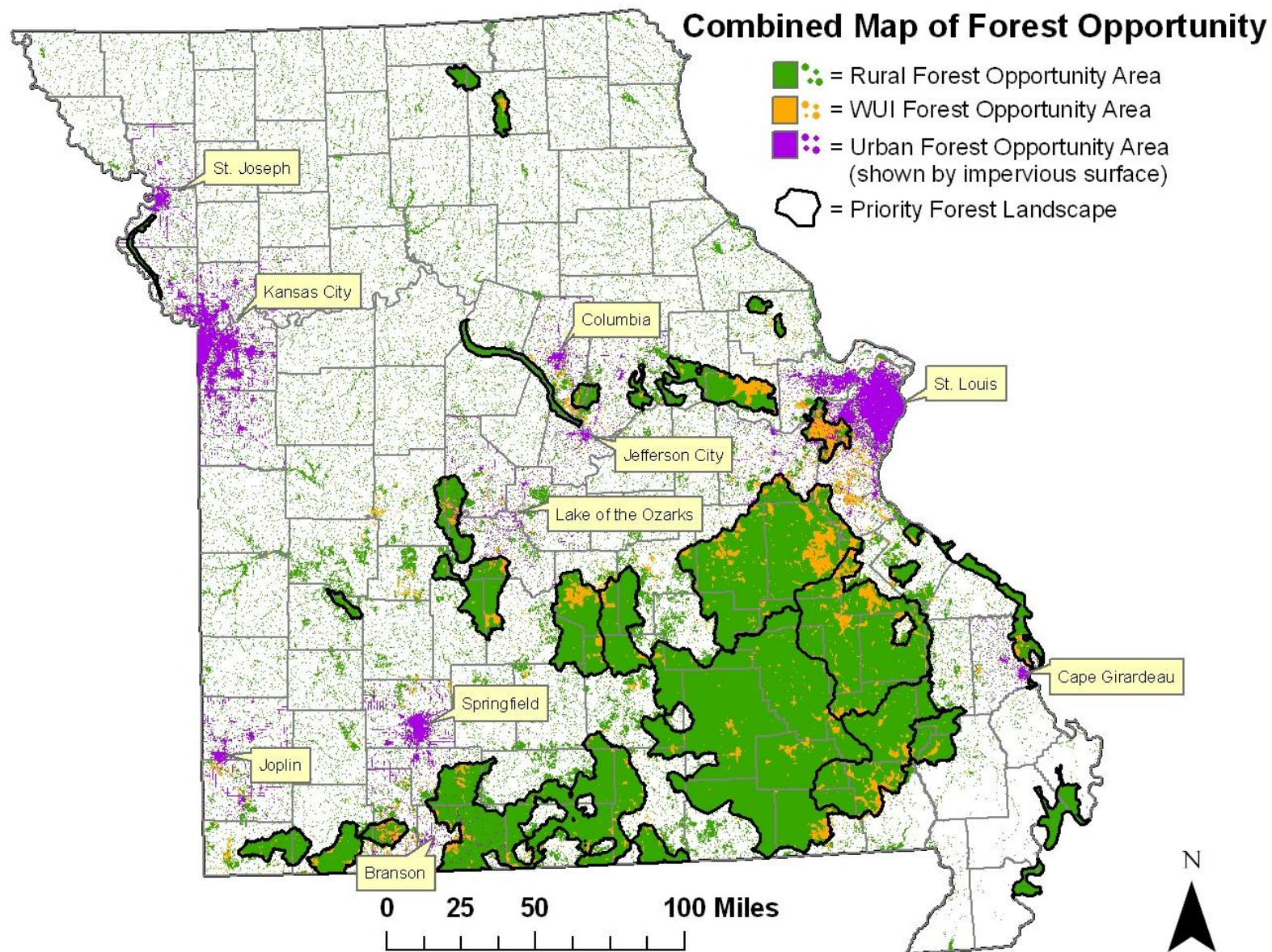
Urban FOA:	Population Estimate 2008	Population estimate includes these counties:
St. Louis	2,014,235	St. Louis County and City, St. Charles, Jefferson, Franklin
Kansas City	1,091,894	Jackson, Clay, Cass, Platt, Ray
Springfield	342,423	Greene, Christian
Columbia/Jefferson City	272,142	Boone, Cole, Callaway
Joplin	172,933	Jasper, Newton
St. Joseph	106,331	Andrew, Buchanan
Lake of the Ozarks	86,474	Camden, Morgan, Miller
Branson	78,574	Stone, Taney
Cape Girardeau	73,243	Cape Girardeau

Strategies pursued in Phase One will be oriented towards developing better information in Urban FOAs so that a more complete assessment of urban forest needs and opportunities can be done in the future. Potential strategies might include Urban Tree Canopy Assessments, Green Infrastructure Planning, and UFORE/STRATUM analyses. These strategies are explained in greater detail in Chapter __.

Phase Two will incorporate newly generated data into a more informative, finer resolution urban forest assessment. At that time, Urban FOAs will likely be revised accordingly. Phase Two is expected to take place in five years when FRAS is scheduled for revision.

The following map shows Urban FOAs nested within concentrations of impervious surface and forested wildland/urban interface. Distinct boundaries of urban forest opportunity areas are not delineated due to the variability of urban Strategies. For instance, the impervious surface layer might work very well for Urban Tree Canopy Assessments. However, regional council of government district boundaries might work better for Green Infrastructure Planning.





Chapter 5: Multi-State Priority Areas

The following list of Multi-State Priority Areas includes several existing and potential priority areas. By and large, potential multi-state priority areas have not been explored with neighboring states. This is because insufficient funds are available to pursue such additional projects at this time. However, potential opportunities are listed below in case such funding would become available in the 5-year period covered by this Assessment and Strategy.

Existing and Potential Multi-State Priority Areas

#	Existing or Potential	Name	States	Issue/Description
1	Potential	St. Louis Metro Urban Area	MO, IL	Emphasis on urban areas that transcend state lines
2	Existing	Kansas City Metro Urban Area	KS, MO	Emphasis on urban areas that transcend state lines
3	Potential	Bentonville, AR/Joplin, MO Urban Area	MO, AR, OK	Emphasis on urban areas that transcend state lines
4	Existing	Upper Mississippi River Forest Partnership	MN, WI, IA, IL, IN, MO	Water pollution, loss of migratory bird habitat, forest loss and fragmentation
5	Existing	Lower Mississippi bottomland areas (i.e. River Bends COA)	MO, KY, TN, IL	Loss of bottomland forests, forest fragmentation, restoration potential
6	Potential	Weston Bend COA/Fort Leavenworth	MO, KC	Forest/woodland landscape restoration opportunities, enhanced by recent COE acquisitions
7	Potential	Missouri/Mississippi Confluence	MO, IL	Habitat restoration and recreational opportunities.
8	Potential	Missouri River corridor	Several	Habitat restoration, water quality and recreational opportunities.
9	Existing	Fire Compact – Big Rivers	IA, IL, IN MO	Fire
10	Potential	Ozark Highlands forest/woodland restoration	MO, AR, OK, IL	Forest/woodland landscape restoration opportunities (i.e. shortleaf pine restoration/expansion)
11	Potential	Ice Storm Recovery Area	MO, AR, KY, TN	Coordinated efforts needed to improve forest health, reduce fuel loading, and improve utilization opportunities for recovery efforts.
12	Potential	Karst areas	IL, IN, MO, KY	Water quality
13	Existing	Central Hardwoods Joint Venture (Partners in Flight)	MO, AR, OK, TN, KY, maybe IL&IN	Maintain viability of native bird populations
14	Potential	Indiana Bat Conservation in the Hardwood Region	MI, IN, IL, PA, MO	Indiana Bat conservation
15	Potential	Loess Hills	MO, NE, IA	Forest/woodland restoration opportunities of rare community types